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## Smoking and E-Cigarette Use Among U.S. Adults During the COVID-19 Pandemic

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**Introduction:** With concerns about tobacco use being a risk factor for severe disease from coronavirus disease 2019 (COVID-19), understanding nicotine and tobacco use patterns is important for preventive efforts. This study aims to understand changes in combustible cigarette and e-cigarette use among U.S. adults.

**Methods:** In August 2020, a cross-sectional survey of a nationally representative sample of adults aged  $\geq 18$  years in the National Opinion Research Center's AmeriSpeak Panel who reported past 6-month use of combustible cigarettes or e-cigarettes was conducted. Multivariable logistic regression assessed factors associated with increased product use and quit attempts since hearing about COVID-19.

**Results:** A total of 1,024 past 6-month cigarette smokers/e-cigarette users were surveyed. Among cigarette smokers, 45% reported no change in cigarette smoking and 33% increased cigarette smoking since hearing about COVID-19. Higher stress was associated with increased cigarette smoking. Among e-cigarette users, 41% reported no change in and 23% reported increasing e-cigarette use. Twenty-six percent of cigarette smokers and 41% of e-cigarette users tried to quit because of COVID-19. Higher perceived risk of COVID-19 was associated with attempts to quit combustible cigarettes (AOR=2.37, 95% CI=1.59, 3.55) and e-cigarettes (AOR=3.14, 95% CI=1.73, 5.70).

**Conclusions:** Cigarette and e-cigarette use patterns varied in response to the COVID-19 pandemic. Most cigarette smokers and e-cigarette users perceived product use as increasing COVID-19-related health risks, and this was associated with attempts to quit. Some cigarette smokers, especially those reporting higher stress, increased product use. Proactive provision of cessation support to smokers and e-cigarette users may help mitigate stress-related increases in product use during the COVID-19 pandemic.

## INTRODUCTION

As cases of coronavirus disease 2019 (COVID-19) continue to increase in the U.S. and worldwide, the management of potentially modifiable factors associated with the risk of severe disease or death is an important component of preventive efforts. Health organizations have identified smoking as a risk factor for severe disease from severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection,<sup>1,2</sup> an association that has also been suggested by several,<sup>3,4,5-7</sup> but not all,<sup>8</sup> systematic reviews. Data on the association between e-cigarette use and

COVID-19 outcomes are lacking, although there has been some concern about e-cigarette use being associated with increased COVID-19 risk among young people.<sup>9</sup>

Many smokers turn to cigarettes when they are stressed. Stressful life events have been negatively associated with quitting smoking,<sup>10</sup> and perceived stress has been associated with nicotine withdrawal symptoms.<sup>11</sup> Therefore, some smokers and e-cigarette users may increase their product use during the uncertain time of a pandemic. At the same time, other smokers might decrease their tobacco use because they have chronic heart or lung disease that they perceive puts them at a higher risk of negative outcomes from COVID-19, or because they have trouble obtaining or using their normal products during business closures or shelter-in-place orders. Thus, as the COVID-19 pandemic could have either positive or negative effects on nicotine and tobacco product use, studies are urgently needed to understand changes in product use among people who smoke cigarettes or use e-cigarettes during the COVID-19 pandemic. A survey of dual users of cigarettes and e-cigarettes in the U.S. done early in the pandemic found that between 20% and 25% of participants had tried to quit cigarettes or e-cigarettes to reduce harm from COVID-19.<sup>12</sup> On the other hand, approximately 30% reported increasing use of cigarettes and e-cigarettes. More recent data from larger, nationally representative groups of smokers and e-cigarette users are needed to further understand these use patterns.

Better understanding of smokers' and e-cigarette users' behaviors and attitudes is important for designing targeted outreach and education for this population. This cross-sectional survey of combustible cigarette smokers and e-cigarette users from a nationally representative sample of

U.S. adults aims to assess: (1) changes in product use as a result of COVID-19, (2) factors associated with increased product use, and (3) factors associated with product quit attempts.

## METHODS

### Study Sample

A cross-sectional survey was conducted among a nationally representative sample of adults in the National Opinion Research Center's AmeriSpeak Panel.<sup>13</sup> For the Amerispeak Panel, U.S. households are sampled using probability- and address-based sampling methods to cover approximately 97% of the U.S. household population. Sampled households are contacted for potential participation in the Amerispeak Panel through mail, telephone, and field interviews, and participants provide informed consent at the time of registration. Most panel members participate in surveys online; households without Internet connection can take surveys by telephone. Panel members participate in surveys approximately 2–3 times a month.

For the present study, eligibility criteria included age  $\geq 18$  years, English-speaking, and use of either combustible cigarettes or electronic nicotine products/e-cigarettes since February 2020 (i.e., past 6-month use). This date was chosen to capture individuals who may have quit cigarette smoking or e-cigarette use just before the pandemic to assess for potential relapse during the pandemic. A screening questionnaire was used to identify past 6-month cigarette and e-cigarette users. E-cigarette users and dual users were sampled separately from cigarette-only users to obtain adequate sample sizes for questions related to e-cigarette use; a quota was set to sample approximately 500 e-cigarette users/dual users and 500 exclusive cigarette smokers. Dual users were not sampled separately as the goal was to evaluate changes in both cigarette and e-cigarette

use among users of each of the 2 products rather than to compare these groups. Only de-identified data were obtained from the National Opinion Research Center, and this study was deemed exempt by the IRB at Mass General Brigham. Surveys were conducted from August 20 to August 25, 2020.

## Measures

Participants reporting past 6-month cigarette or e-cigarette use were asked whether they currently used the products every day, some days, or not at all, and how long they had been using the products. Current product use was defined as current everyday or someday use. Dual use was defined as use of both cigarettes and e-cigarettes in the past 6 months.

With respect to COVID-19 and change in product use, past 6-month cigarette smokers were asked: *Since hearing about the coronavirus (COVID-19), would you say the amount you are smoking has...* Answer choices were: (1) *increased a lot*, (2) *increased a little*, (3) *stayed about the same*, (4) *decreased a little*, or (5) *decreased a lot*. For regression models, this was dichotomized into “increased” and “not increased.” Current cigarette smokers reported whether hearing about COVID-19 affected their interest in reducing or stopping smoking (*yes, less interested; yes, more interested; or no, not affected*), and whether hearing about COVID-19 has led them to try to stop smoking (*yes/no*). Trying to quit smoking was defined as reporting: (1) that COVID led them to try to stop smoking or (2) that they had completely stopped smoking since hearing about COVID-19. Past 6-month e-cigarette users were asked the same questions about use of e-cigarettes, and dual users of cigarettes and e-cigarettes were asked these questions about both products.

Past 6-month cigarette smokers were asked their opinion about smoking and their risk of getting COVID-19 or having a more serious case in any way (*smoking definitely increases my risk, smoking might increase my risk, smoking does not affect my risk, smoking might decrease my risk, smoking definitely decreases my risk*). Past 6-month e-cigarette users were asked the same question about e-cigarette use and COVID risk.

All participants were asked whether they had been tested for COVID-19 or told by a medical professional that they were infected with COVID-19. Potential stressors were assessed by asking participants about whether COVID-19 changed how much time they spend working and how much they worry about having financial problems as a result of the COVID-19 pandemic (on a 5-point scale from *not at all* to *very much*). Participants also completed the Perceived Stress Scale 4,<sup>14</sup> which is scored from 0 to 16, with higher levels indicating higher stress. This scale is not specific to COVID-19 but was asked of participants during the COVID-19 pandemic.

Sociodemographic factors included age, sex, race/ethnicity, level of education, and region of residence.

### **Statistical Analysis**

First, cigarette and e-cigarette use behaviors and perceived risks related to COVID-19 were described. Then, univariable logistic regression analyses were conducted to assess predictors of: (1) increased cigarette smoking or e-cigarette use due to COVID-19, (2) trying to quit cigarette smoking or e-cigarette use, or (3) increased interest in reducing or stopping cigarette smoking or e-cigarette use among participants who were still using the products at the time of the survey. Variables with  $p < 0.15$  in univariable analyses were included in multivariable logistic regression



models with sociodemographic characteristics and cigarette or e-cigarette use. Only participants with complete data on study variables were included in the multivariable models. All analyses adjusted for complex survey procedures and sample weights using Stata, version 13. Sample weights are adjusted for non-response and are raked to population controls derived from the Current Population Survey. All  $n$ 's are reported as unweighted and all percentages are weighted.

## RESULTS

Overall, 4,734 of the 20,455 (23.1%) invited Amerispeak Panel members completed the screening questionnaire. Of these individuals, 678 (14.3%) reported either e-cigarette use or dual use of e-cigarettes and cigarettes in the past 6 months and 549 (11.6%) reported cigarette smoking only during this time and were therefore eligible for the survey. Among those eligible, 507 (74.7%) of the e-cigarette or dual users and 517 (94.3%) of the cigarette smokers completed the survey. Among those in the e-cigarette sample, 336 reported using e-cigarettes only, and 171 reported both smoking cigarettes and using e-cigarettes. Characteristics of the study population by past 6-month use of cigarettes and e-cigarettes are shown in Table 1.

Among cigarette smokers who had smoked since hearing about COVID-19 ( $n=601$ ), 45% reported no change in cigarette smoking, 21% reported decreased cigarette smoking, and 33% reported increased cigarette smoking (Figure 1A). These proportions did not differ significantly between cigarette-only smokers and dual users ( $p=0.30$ , data not shown in tables). Among past 6-month cigarette smokers who reported quitting prior to the COVID-19 pandemic ( $n=85$ ), 15% reported relapsing back to cigarette smoking. In multivariable analyses, factors associated with increased cigarette smoking among participants who had smoked since hearing about COVID-19

were higher perceived stress, greater worry about financial problems due to the COVID-19 pandemic, and working more during the pandemic (Table 2).

Among e-cigarette users who had used e-cigarettes since hearing about COVID-19 ( $n=384$ ), 41% reported no change in use, 37% reported decreased use, and 23% reported increased use (Figure 1B). E-cigarette-only users and dual users did not differ significantly on this measure ( $p=0.85$ ). Among past 6-month e-cigarette users who reported quitting prior to the COVID-19 pandemic ( $n=113$ ), most (82%) reported staying quit while 18% reported relapsing back to e-cigarette use. In multivariable analyses, increased e-cigarette use since hearing about COVID-19 was associated with female sex and negatively associated with residing in the Midwest or South (versus Northeast), but associations with COVID-19 factors (financial stress, work hours, COVID-19 risk) were not significant (Table 2).

Most (63%) past 6-month cigarette smokers perceived that cigarette use *might increase* or *definitely increases* their risk of contracting COVID-19 or having a more serious outcome, whereas 32% did not think cigarette smoking affected their risk (Appendix Figure 1). Perceived risk of COVID-19 did not differ significantly between cigarette-only smokers and dual users ( $p=0.22$ , data not shown in tables). Similarly, most (59%) past 6-month e-cigarette users reported feeling that e-cigarette use *might increase* or *definitely increases* their risk of COVID-19 or a more serious outcome, whereas one third (33%) did not think e-cigarette use affected their risk (Appendix Figure 1). E-cigarette-only users and dual users did not differ significantly in perceived risk of COVID-19 ( $p=0.89$ ).

Among participants who had smoked cigarettes since hearing about COVID-19, 26% reported trying to quit because of COVID-19. Dual users did not differ significantly from cigarette-only users in trying to quit ( $p=0.07$ ). The belief that smoking increases risk of COVID-19 or having a more severe case was associated with trying to quit cigarette smoking, and daily smoking and more years of cigarette smoking were negatively associated with trying to quit (Table 3). Among participants who were still smoking at the time of the survey, 35% reported increased interest in quitting smoking and this did not differ significantly between dual users and cigarette-only users ( $p=0.90$ ). The belief that smoking increases risk of COVID-19 or having a more severe case was associated with increased interest in quitting or reducing cigarette smoking (AOR=2.82, 95% CI=1.98, 4.02), whereas daily smoking was negatively associated with increased interest in quitting or reducing cigarette smoking (AOR=0.35, 95% CI=0.19, 0.63).

Among participants who had used e-cigarettes since hearing about COVID-19, 41% reported trying to quit e-cigarettes because of COVID-19. Dual users did not differ significantly from e-cigarette-only users in trying to quit ( $p=0.11$ ). The belief that e-cigarette use increases risk of COVID-19 or having a more severe case was associated with trying to quit e-cigarettes, whereas daily e-cigarette use and past 6-month cigarette smoking were negatively associated with trying to quit e-cigarettes (Table 3). Among participants who were still using e-cigarettes at the time of the survey, 43% reported increased interest in quitting e-cigarette use and this did not differ significantly between dual users and e-cigarette-only users ( $p=0.53$ ). The belief that e-cigarette use increases risk of COVID-19 or having a more severe case was associated with increased interest in quitting or reducing e-cigarette use (AOR=2.14, 95% CI=1.48, 3.09) as was working more during the pandemic (AOR=4.01, 95% CI=1.32, 12.21), whereas daily e-cigarette use was

negatively associated with increased interest in quitting or reducing e-cigarette use (AOR=0.25, 95% CI=0.12, 0.54).

## DISCUSSION

Among cigarette smokers and e-cigarette users in a nationally representative panel of U.S. adults, product use patterns and behaviors varied in response to the COVID-19 pandemic.

Approximately a third of cigarette smokers and a quarter of e-cigarette users increased their product use during the pandemic, and personal and economic stressors were associated with increased use among cigarette smokers. At the same time, 26% of cigarette smokers and 41% of e-cigarette users reported trying to quit product use during the pandemic. Most cigarette smokers and e-cigarette users perceived their product use as increasing their risk of COVID-19 or a more serious outcome. Higher perceived risk related to COVID-19 was associated with attempts to quit both cigarettes and e-cigarettes, whereas daily product use was negatively associated with quit attempts. The study findings highlight the range of behavioral responses that users of addictive products have had in response to an ongoing pandemic.

Similar to prior studies, 33% of cigarette smokers and 23% of e-cigarette users increased their product use.<sup>12,15</sup> Prior studies have found that although some e-cigarette users had concerns about product access during the COVID-19 pandemic, many were still able to obtain the products either through stockpiling of products, online purchasing, or from their usual channels either through vape shop non-compliance with or circumventing of business closure orders.<sup>16–18</sup> In the present study, factors associated with various forms of stress—total stress, worry about financial problems, and increased working hours—were associated with increased cigarette smoking

during the COVID-19 pandemic. A study of current smokers in the United Kingdom during the COVID-19 pandemic also found an association between psychosocial and mental health factors and changes in cigarette consumption.<sup>19</sup> These data are consistent with findings from non-pandemic times in which high stress levels have been associated with continued cigarette smoking, and the association between changes in perceived stress and changes in smoking status.<sup>20</sup> Targeted outreach to smokers during the pandemic to assist with stress management and avoidance of smoking escalation can help to mitigate stress-related increases in smoking consumption. This can be facilitated by health systems' screening for and addressing social determinants of health among all patients. Proactively offering cessation assistance outside of in-person healthcare visits may also help smokers to quit during the pandemic and can capture individuals who are hesitant to seek in-person care. Prior work has shown the effectiveness of proactive smoking-cessation support and referrals to community-based resources in smokers with low SES.<sup>21</sup> Cessation should remain a key goal, particularly as tobacco use continues to be the leading preventable cause of death worldwide.

Increased interest in quitting product use was reported by 35% of cigarette smokers and 43% of e-cigarette users during the COVID-19 pandemic, consistent with other, non-representative samples of U.S. adults surveyed earlier in the pandemic.<sup>12,15</sup> Therefore, the pandemic may be a time of increased receptiveness to help for tobacco cessation. A study in the United Kingdom found higher odds of trying to quit and of quitting among past-year smokers after a COVID-19 lockdown, and though smokers were no more likely to use evidence-based smoking-cessation treatment after the lockdown, use of remote smoking-cessation support in the form of telephone support, websites, or telephone applications increased during this time.<sup>22</sup> Bolstering access to

tobacco-cessation resources that do not require in-person contact may be one way for smokers and e-cigarette users to act on their interest in quitting and successfully quit. Eliminating co-payments for smoking-cessation medications and use of social media marketing campaigns that also increase public awareness of resources such as national smoking quitlines can aid these efforts. This is important as use of smoking quitlines decreased during the COVID-19 pandemic.<sup>23</sup>

In line with the present findings related to perceived risk of COVID-19 and attempts to quit, prior work by Grummon et al.<sup>24</sup> using a convenience sample of U.S. adults found that both messaging related to traditional harms of smoking and those specifically related to COVID-19 had higher perceived effectiveness for discouraging smoking compared with control messages. By contrast, although messaging about traditional harms of e-cigarette use were associated with higher perceived effectiveness for discouraging e-cigarette use compared with control, the same was not seen for COVID-19-related messages.<sup>24</sup> Thus, education of smokers on the relationship between smoking and COVID-19 risk may serve as an important motivator for cessation and reducing potential increases in product use. Further research is necessary to assess the effects of public health messaging on smoking and vaping during the pandemic and optimize messaging content for these individuals. In the meantime, clinicians and public health officials should emphasize the increased risk of COVID-19 for smokers in conversations with patients and in public health messaging.

### **Limitations**

This study is subject to several limitations. First, data are cross-sectional and therefore longitudinal trends in cigarette and e-cigarette use could not be assessed. Second, all data are

self-reported, including retrospective reports of use patterns, and therefore subject to errors in recall. Third, questions about risk perceptions combined perceived risk of getting COVID-19 and having a more serious case, so the answers to the individual components of this question cannot be ascertained. Finally, data were collected at the end of August 2020, when COVID-19 cases were lower compared with Spring 2020 and Fall 2020, and therefore participant behaviors may not be reflective of behaviors at other times during the pandemic.

## CONCLUSIONS

This survey of a large nationally representative sample of cigarette smokers and e-cigarette users in the U.S. revealed a range of product use behaviors in response to the COVID-19 pandemic, with some trying to quit product use and others increasing their product use. Most cigarette smokers and e-cigarette users perceived higher COVID-19-related health risks as a result of their product use, factors that appeared to be associated with attempts to quit product use. Outreach to cigarette smokers and e-cigarette users to provide cessation assistance during this time may help to support quit attempts and reduce stress-related increases in product use.

### CRedit Author Statement

**Sara Kalkhoran:** Conceptualization, Methodology, Investigation, Formal analysis, Writing – Original Draft.

**Douglas E. Levy:** Conceptualization, Methodology, Writing – Review and Editing.

**Nancy A. Rigotti:** Conceptualization, Methodology, Investigation, Writing – Review and Editing, Supervision.

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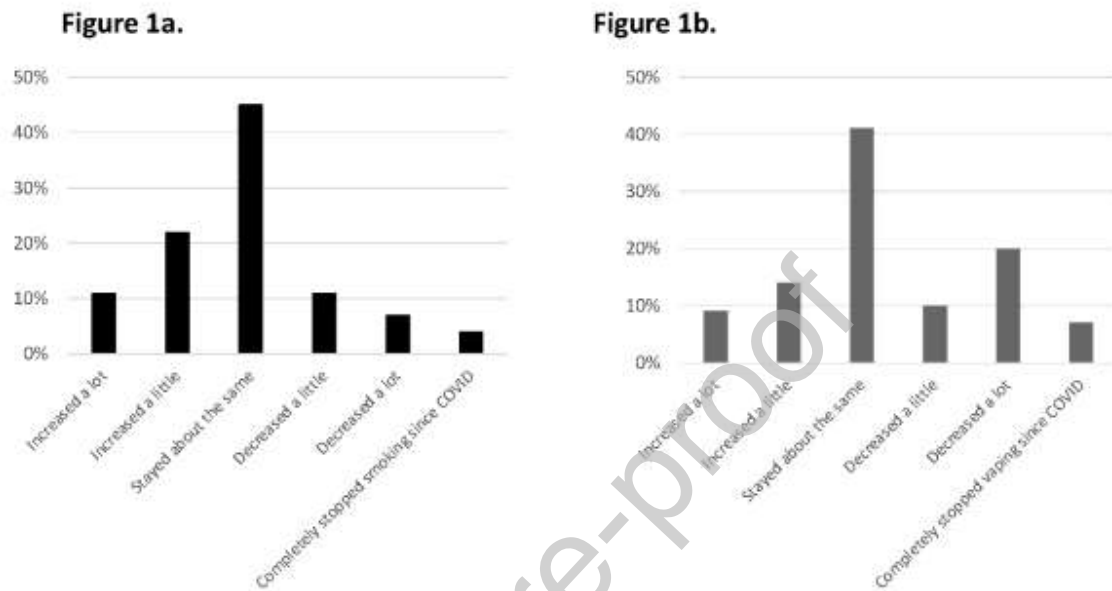


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**Figure 1.** (a) Cigarette smoking behaviors among past 6-month cigarette smokers who reported having smoked cigarettes since hearing about COVID-19. (b) E-cigarette use among past 6-month e-cigarette users who reported having used e-cigarettes since hearing about COVID-19.

**Table 1.** Characteristics of Individuals Reporting Past 6-Month Cigarette Smoking or E-Cigarette Use

<b>Variables</b>	<b>Past 6-month smokers (n=688)<sup>a</sup> % (n)</b>	<b>Past 6-month e-cigarette users (n=507)<sup>a</sup> % (n)</b>
Age in years, mean (SD)	45 (1.0)	36 (0.8)
Female	54 (350)	43 (233)
Race/ethnicity		
Non-Hispanic White	66 (466)	57 (288)
Non-Hispanic Black	11 (100)	15 (88)
Hispanic	15 (69)	22 (95)
Other	8 (53)	7 (36)
Level of education		
High school or less	53 (215)	51 (153)
Some college	27 (340)	29 (228)
4-year degree or more	19 (133)	20 (126)
Region		
Northeast	18 (116)	13 (68)
Midwest	25 (212)	20 (136)
South	38 (220)	42 (156)
West	18 (140)	26 (147)
Cigarette smoking		
Past 6-month cigarette smoking	100 (688)	34 (171)
Current cigarette smoking	81 (553)	27 (128)
Current daily cigarette smoking	56 (393)	18 (80)
E-cigarette use		
Past 6-month e-cigarette use	29 (171)	100 (507)
Current e-cigarette use	21 (124)	67 (336)
Current daily e-cigarette use	6 (39)	17 (95)
Duration of cigarette smoking (current users)	22 years (0.9)	16 years (1.4)
Duration of e-cigarette use (current users)	2.5 years (0.3)	2 years (0.1)
Total stress score (0–16), mean (SD)	6.5 (0.2)	6.9 (0.2)
COVID affected finances	67 (436)	77 (378)
Have had to use savings	29 (187)	30 (149)
Had to borrow money/get loan	21 (121)	20 (94)
Could not make bill payments	20 (116)	23 (107)
Cut down on spending for food	27 (182)	32 (154)
Needed to cut down on expenses in general	45 (303)	40 (208)
Mean number of finances affected	1.4 (0.1)	1.4 (0.1)
Worry about financial problems (1 – not at all, 5 – very much)	2.8 (0.1)	2.9 (0.1)
COVID affected work hours		
Lost job	13 (79)	14 (82)

Yes, working less	14 (83)	22 (91)
Yes, working more	7 (35)	11 (47)
No, working same	33 (240)	34 (168)
No, not working before COVID	33 (248)	19 (112)
Tested for COVID	27 (135)	38 (171)
Diagnosed with COVID	2 (11)	8 (34)

<sup>a</sup>Groups are not mutually exclusive.

**Table 2.** Predictors of Increased Cigarette Smoking or E-Cigarette Use Due to COVID-19

Variables	Increased cigarette smoking due to COVID-19 (n=596)		Increased e-cigarette use due to COVID-19 (n=378)	
	OR (95% CI)	AOR <sup>a</sup> (95% CI)	OR (95% CI)	AOR <sup>a</sup> (95% CI)
Age	<b>0.97 (0.96, 0.99)</b>	0.99 (0.97, 1.01)	1.01 (0.99, 1.03)	1.01 (0.99, 1.03)
Female	1.15 (0.68, 1.95)	1.09 (0.66, 1.81)	1.79 (0.99, 3.23)	<b>1.96 (1.08, 3.54)</b>
White race	0.70 (0.40, 1.23)	0.89 (0.52, 1.54)	0.84 (0.47, 1.51)	0.97 (0.54, 1.75)
Education				
High school or less	1.69 (0.91, 3.15)	1.13 (0.59, 2.17)	0.58 (0.28, 1.18)	0.60 (0.27, 1.33)
Some college	1.18 (0.67, 2.09)	0.78 (0.41, 1.47)	0.88 (0.47, 1.66)	0.69 (0.31, 1.50)
4-year degree or more	ref	ref	ref	ref
Region of residence				
Northeast	ref	ref	ref	ref
Midwest	1.13 (0.61, 2.12)	1.15 (0.56, 2.35)	<b>0.33 (0.13, 0.87)</b>	<b>0.36 (0.13, 0.96)</b>
South	0.54 (0.28, 1.04)	0.48 (0.22, 1.05)	<b>0.23 (0.10, 0.56)</b>	<b>0.27 (0.11, 0.68)</b>
West	1.19 (0.50, 2.86)	0.89 (0.39, 2.02)	0.61 (0.25, 1.48)	0.56 (0.23, 1.38)
Past 6-month cigarette smoking	–	–	1.13 (0.62, 2.09)	1.23 (0.65, 2.33)
Past 6-month e-cigarette use	1.23 (0.71, 2.12)	1.19 (0.67, 2.13)	–	–
Total stress score (0–16)	<b>1.23 (1.13, 1.33)</b>	<b>1.15 (1.06, 1.26)</b>	<b>1.11 (1.01, 1.21)</b>	1.09 (0.99, 1.20)
Worry about financial problems (1 – not at all, 5 – very much)	<b>1.62 (1.32, 1.98)</b>	<b>1.31 (1.04, 1.67)</b>	1.14 (0.90, 1.43)	–
COVID affected work hours				
Working less	<b>2.05 (1.20, 3.49)</b>	1.28 (0.69, 2.36)	<b>1.95 (1.05, 3.62)</b>	1.82 (0.96, 3.42)
Working more	<b>5.58 (1.60, 19.43)</b>	<b>2.98 (1.06, 8.34)</b>	0.61 (0.23, 1.62)	0.70 (0.26, 1.89)
No change	ref	ref	ref	ref
Perceived risk of COVID from smoking/e-cigarette use (1 – definitely decreases, 5 – definitely increases)	1.19 (0.93, 1.53)	–	<b>1.42 (1.01, 1.99)</b>	1.28 (0.91, 1.78)

Note: Boldface indicates statistical significance ( $p < 0.05$ ).

<sup>a</sup>Variables denoted with – were not included in multivariable models. All other variables were adjusting covariates.

**Table 3.** Predictors of Trying to Quit Cigarette Smoking or E-Cigarette Use Due to COVID-19

Variables	Tried to quit cigarette smoking because of COVID-19 (n=557)		Tried to quit e-cigarette use because of COVID-19 (n=301)	
	OR (95% CI)	AOR <sup>a</sup> (95% CI)	OR (95% CI)	AOR <sup>a</sup> (95% CI)
Age	1.00 (0.98, 1.02)	<b>1.04 (1.02, 1.07)</b>	0.99 (0.97, 1.02)	0.99 (0.96, 1.02)
Female	1.05 (0.62, 1.80)	1.48 (0.83, 2.62)	1.24 (0.68, 2.25)	1.35 (0.63, 2.89)
White race	0.61 (0.34, 1.08)	0.63 (0.35, 1.14)	0.63 (0.34, 1.15)	0.75 (0.33, 1.73)
Education				
High school or less	1.14 (0.59, 2.20)	2.34 (0.95, 5.75)	1.25 (0.60, 2.58)	1.74 (0.69, 4.37)
Some college	0.97 (0.53, 1.78)	1.69 (0.71, 4.03)	0.72 (0.36, 1.44)	0.75 (0.31, 1.80)
4-year degree or more	ref	ref	ref	ref
Region of residence				
Northeast	ref	ref	ref	ref
Midwest	1.66 (0.83, 3.29)	2.19 (1.03, 4.66)	0.75 (0.30, 1.86)	0.62 (0.20, 1.93)
South	1.89 (0.96, 3.69)	1.94 (0.87, 4.35)	0.82 (0.34, 2.01)	0.67 (0.22, 2.06)
West	1.44 (0.52, 3.94)	1.41 (0.51, 3.87)	1.01 (0.40, 2.54)	0.71 (0.20, 2.49)
Past 6-month cigarette smoking	–	–	0.59 (0.31, 1.13)	<b>0.45 (0.21, 0.96)</b>
Past 6-month e-cigarette use	1.73 (0.95, 3.15)	1.68 (0.76, 3.69)	–	–
Duration of cigarette smoking	<b>0.98 (0.96, 0.99)</b>	<b>0.97 (0.95, 0.99)</b>	–	–
Duration of e-cigarette use	–	–	0.93 (0.75, 1.14)	–
Daily cigarette smoking	<b>0.21 (0.12, 0.37)</b>	<b>0.21 (0.11, 0.38)</b>	–	–
Daily e-cigarette use	–	–	<b>0.21 (0.09, 0.45)</b>	<b>0.23 (0.10, 0.55)</b>
Total stress score (0–16)	1.02 (0.96, 1.09)	–	1.09 (0.99, 1.20)	1.05 (0.92, 1.19)
Worry about financial problems (1 – not at all, 5 – very much)	1.12 (0.93, 1.34)	–	1.19 (0.95, 1.51)	0.99 (0.71, 1.37)
COVID affected work hours				
Working less	1.21 (0.65, 2.26)	–	1.67 (0.87, 3.17)	1.32 (0.55, 3.15)
Working more	1.18 (0.32, 4.33)	–	1.34 (0.50, 3.60)	0.99 (0.32, 3.09)
No change	ref	–	ref	ref
Perceived risk of COVID from smoking/e-cigarette use (1 – definitely decreases, 5 – definitely increases)	<b>2.17 (1.45, 3.23)</b>	<b>2.37 (1.59, 3.55)</b>	<b>2.31 (1.48, 3.60)</b>	<b>3.14 (1.73, 5.70)</b>

Note: Boldface indicates statistical significance ( $p < 0.05$ ).



<sup>a</sup>Variables denoted with – were not included in multivariable models. All other variables were adjusting covariates.